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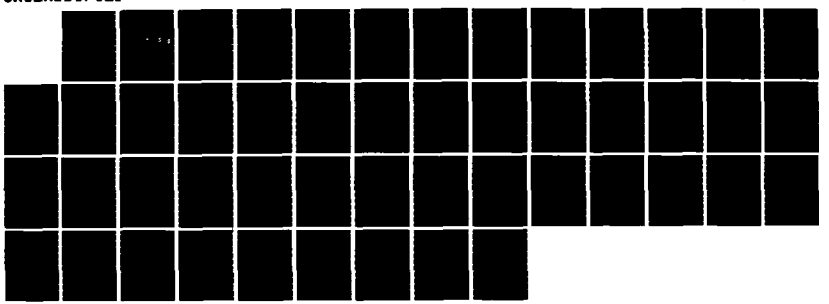

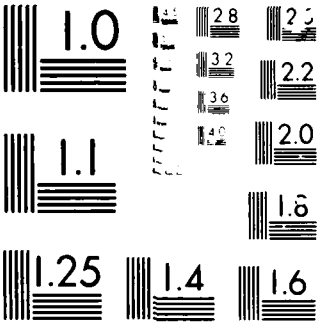
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Communication systems requirements analysis is an essential ingredient for developing new communication systems. Unfortunately, system development groups consisting of system users, analysts, and managers have not been very effective in performing the requirements analysis. Users have been unable to communicate what they want, the technical ideas suggested by the analysts reflect their particular interests, and the managers have been unable to facilitate the interactions between the users and the analysts. This has resulted in systems that are inadequate.

Many techniques have been suggested to improve the effectiveness of system development but none have been particularly useful. There has been recent evidence to indicate that poor requirements analysis is related to the cognitive styles of the members of the system development groups. It suggests that a mix of possible cognitive styles is required for effective system analysis and design, and that imbalances of cognitive styles may

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Do Cognitive Styles Affect the Performance of System Development Groups?

by

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Lieutenant, United States Navy
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Submitted in partial fulfillment of the requirements for the degree of

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ABSTRACT

Communication systems requirements analysis is an essential ingredient for developing new communication systems. Unfortunately, system development groups consisting of system users, analysts, and managers have not been very effective in performing the requirements analysis. Users have been unable to communicate what they want, the technical ideas suggested by the analysts reflect their particular interests, and the managers have been unable to facilitate the interactions between the users and the analysts. This has resulted in systems that are inadequate.

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This thesis evaluates the status of measuring group performance and considers the useful tools for measuring cognitive styles. The emphasis is on the Myers-Briggs Type Indicator and its utility as the primary tool for determining cognitive styles.

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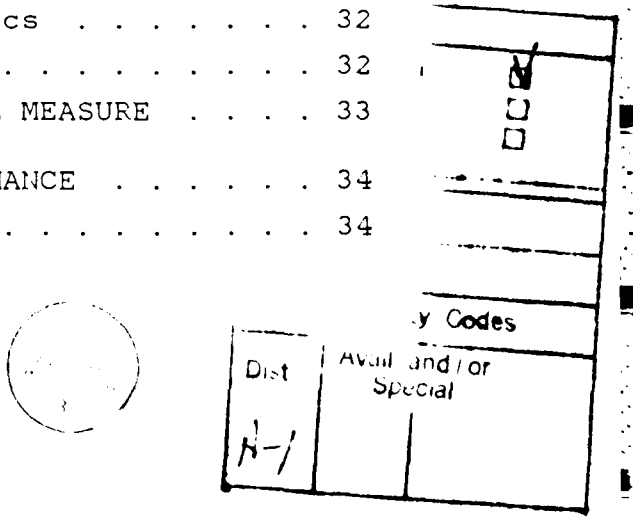

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I. INTRODUCTION

Computers are critical components used to accomplish the modern military mission. Almost every military system in the current and planned U. S. military force structure uses computer subsystems. Military communications systems are no exception to this. For example, the Naval Communications Processing and Routing System (NAVCOMPARS) and the Local Digital Message Exchange (LDMX) use the Univac 90/60 and 70/45 computers as their Central Processing Units (CPU). These systems are the major components of the Naval Telecommunications System. They automate the routing, formatting, validation, transmission, editing, retransmission, and readdressing of naval messages.

Communication systems are typically designed by a project team comprised of system users, analysts (designers), and a program manager. The system user is someone who would actually use the system out in the fleet. The analyst/designer is an engineer who is computer or technology oriented, and the program manager is the person responsible for coordinating the efforts of the users and the analysts as they move toward the team's objective.

The process of system analysis and design is fundamental to the creation of computer based systems. However, too much emphasis is often placed on the detailed system design and implementation phases. Skill in these phases is of no use if the system requirements are not well understood and/or the overall design of the system is poorly chosen or poorly structured. A technically elegant implementation of functions which no one really needs, or which are difficult and cumbersome to use is not a successful system. [Ref. 1: p. 25]

Even when the technology for designing a computer-based system is readily available, failures in systems of this type are often caused by the difficulty of deciding exactly what the system ought to do - and this in turn is caused by the difficulty in communication between system analysts and system users. [Ref. 1: p. 26]

The influence of the user and the communication process through which agreement between user and analyst is achieved have been singled out as essential to the success of a system development project. Each party brings a different conceptual framework into the interaction in terms of personality and behavior characteristics and this will determine how each party will view the problem at hand. [Ref. 2: p. 592]

These conceptual differences are one of the primary reasons for the existence of a communications gap between users and analysts. This gap can be broadly summarized with two general observations:

- Users have more difficulty expressing requirements in the structured form necessary for computerization
- Analysts tend to deal with problems in a logical framework and are usually more interested in technical concerns

This semantic gap must be bridged to ensure the design of quality communication systems. [Ref. 3: p. 43]

Given the differing nature of the two major groups involved in systems development, it is apparent that it takes a special kind of individual to lead the group effectively. The work of Lawrence and Lorsch suggests that an effective leader in a highly differentiated group such as this would be the one who could span the two worlds of the groups involved. In other words, the time, goal, and interpersonal orientations of the program manager should be situated midway between those of the users and the analysts. [Ref. 4: p. 45]

Program managers are often assigned without due consideration to the special talent needed to effectively bridge the natural gap between users and analysts. The above research suggests, however, that higher effectiveness can be achieved if an individual is identified who occupies this middle ground of orientations. The program manager must understand the methods of thinking, methods of operating, and points of view of the two groups if effective communication, coordination, and integration is to be achieved. The good leader, therefore, will be one who is perceived by the team members as independent of any particular point of view or goal except the project's success. Thus, very careful attention must be given to the selection of the program manager, for this selection on its own can determine the success or failure of the project. [Ref. 4: p.45]

This thesis hypothesizes the existence of significant differences in cognitive styles between members of system development groups and the relationship between these differences and system success or failure. Chapter II will discuss some different theories of cognitive style and propose the use of the Myers-Briggs Type Indicator(MBTI) as the most suitable tool for determining cognitive style. Chapter III will examine the ways to measure group performance and propose one or more of these measures as appropriate for predicting the performance of system development groups. Chapter IV will provide evidence that the cognitive styles of members of system development groups are related to the performance of the group and also that a mix of cognitive styles within the group is necessary for successful performance. Chapter V will provide a summary of the thesis and some conclusions reached by the author.

II. COGNITIVE STYLE

A. INTRODUCTION

Within the past 15 years, design literature has reflected an increased attention to the psychological characteristics of the decision maker. An understanding of the variables and the processes involved in human information processing and decision making is a prerequisite to improving human decisions. One of the psychological categories which has received attention is "cognitive styles". An individual's cognitive style is the strategy or group of strategies that the individual typically adopts in approaching the solving of a wide variety of problem situations situations. This Chapter will look at the different variations in cognitive style in regard to the way people make decisions, describe the Myers-Briggs Type Indicator (MBTI), cite some studies that have used the MBTI, and discuss the validity of the MBTI.

B. COGNITIVE STYLE FRAMEWORKS

1. Analytic/Hueristic

Huysman in [Ref. 5] proposed a single dimension which identified unique ways of reasoning termed analytic and hueristic. Analytic individuals reduce problems to a set of underlying relationships. These relationships, frequently in the form of an explicit model, are used to choose among alternative courses of actions. Hueristic individuals were thought to emphasize pragmatic solutions, often identified by recalling a solution to an analogous problem. Common sense and intuition play an important role for the hueristic decision maker. [Ref. 6: p.372]

Huysman's ways of reasoning are similar to the field dependence ideas developed by Witkin in [Ref. 7]. Field

independence is the ability to separate an object or phenomenon from its environment. Individuals showing high field independence were thought to prefer problem solving approaches which emphasized detail and basic relationships. The field dependent person shows less ability to separate objects from their environment. Field dependent individuals would prefer more global, perhaps intuitive, approaches to problem solving. Witkin developed the embedded figures test to detect field independence and field dependence in people. [Ref. 6: p. 372]

2. Cognitive Complexity

Several frameworks consisting of multiple dimensions have been proposed to study decision making. Driver and Mock [Ref. 8] using cognitive complexity notions, such as information overloads, described style in terms of the number of solutions and the amount of information used. Four independent styles emerge, each having strengths and weaknesses. They call a preference for minimal data and a single solution, a decisive style. A flexible style stems from a preference for multiple solutions with minimal data. Those who seek a maximum amount of data and single solutions are called hieractic. Preferences for multiple solutions and maximum data lead to an integrative style. [Ref. 6: p. 372]

3. Information Gathering and Evaluation

McKeeney and Keen [Ref. 9: p. 86] view problem solving and decision making in terms of the processes through which individuals organize the information they perceive in their environment, bringing to bear habits and strategies of thinking. They proposed a framework which is based on the dual premise that consistent modes of thought develop through training and experience and that these modes can be classified along two dimensions, information gathering and information evaluation. The levels of the two dimensions are seen as independent and non-dominating,

forming four characteristic decision styles called systematic-perceptive, systematic-receptive, intuitive-perceptive, and intuitive-receptive. See Figure 2.1 [Ref. 6: p. 372]

Information gathering relates to the essentially perceptual process by which the mind organizes the diffuse verbal and visual stimuli it encounters. The resultant information is the outcome of a complex coding that is heavily dependent on mental set, memory capacity, and strategies, that serve to ease cognitive strain. Of necessity, information gathering involves rejecting some of the data encountered, and summarizing and categorizing the rest. [Ref. 9: p. 80]

Perceptive individuals bring to bear concepts to filter data. They focus on relationships between items and look for deviations from or conformities with their expectations. Their precepts act as cues for both gathering and cataloging the data they find. Receptive thinkers are more sensitive to the stimulus itself. They focus on detail rather than relationships and try to derive the attributes of the information from direct examination of it instead of from fitting it to their precepts. [Ref. 9: p. 80]

Each mode of information gathering has its advantages in specific situations; equally, each includes risks of overlooking the potential meaning of data. The perceptive individual too easily ignores relevant detail, while the receptive thinker may fail to shape detail into a coherent whole. [Ref. 9: p. 81]

Information evaluation refers to processes commonly classified under problem solving. Individuals differ not only in their method of gathering data but also in their sequence of analysis of that data. Systematic individuals tend to approach a problem by structuring it in terms of some method which, if followed through, leads to a likely

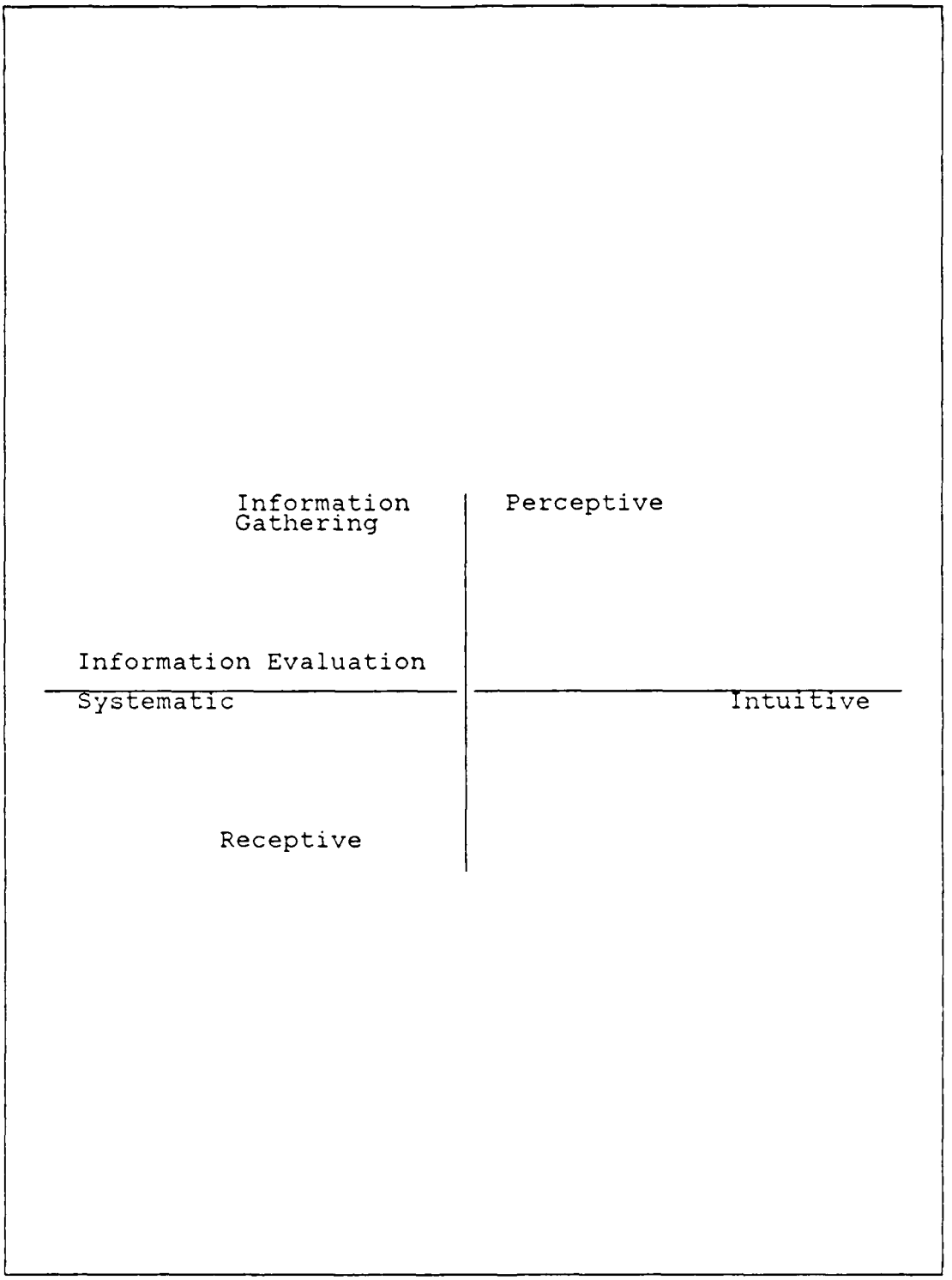

Figure 2.1 Model of Cognitive Style.

solution. Intuitive thinkers usually avoid committing themselves in this way. Their strategy is more one of solution testing and trial and error. They are much more willing to jump from one method to another, to discard information, and to be sensitive to cues that they may not be able to identify verbally. [Ref. 9: p. 81]

Here again, each mode of information evaluation has advantages and risks. An intuitive thinker often reinvents the wheel each time he/she deals with a particular problem. However, the intuitive person is better able to approach ill-structured problems where the volume of data, the criteria for solution, or the nature of the problem itself do not allow the use of any predetermined method. [Ref. 9: p. 81]

4. Jungian Typology

One of the primary themes running throughout the behavorial research is the basic difference in the way people perceive and evaluate information. A main contributor to the literature concerning these differences is the Swiss psychologist, C. G. Jung. His theory is based on the assumption that much apparently random variation in human behavior is actually quite orderly and consistent, due to certain basic differences in the way people approach life. [Ref. 10: p. 461]

Jung postulates two attitudes - extraversion and introversion - and four functions - sensation (S), intuition (N), thinking (T), and feeling (F) - which interlock in the sense that extraversion and introversion indicate the focus of cognitive activity and the four functions describe its specific varieties. [Ref. 10: p. 461]

Extraversion and introversion describe the person's preferred orientation to life. Extraverted types are regarded as being oriented primarily to the outer world of objects, people, and action, having a tendency to get caught

up with whatever is happening around them. Introverted types have a more inward orientation and tend to detach themselves from the world around them. [Ref. 10: p. 461]

Sensing and intuition describe two distinct ways of perceiving things. Sensing types focus on perceptions received directly through their sense organs; they notice the concrete details and practical aspects of a situation. Intuitive types look at things more vaguely, so as to get a certain spontaneous hunch from the unconscious; they like to deal with abstractions, inferred meanings, and the hidden possibilities in a situation. [Ref. 10: p. 461]

Thinking and feeling describes the person's preferred way of making decisions. Thinking types rely on logical structures to put classifying order into a particular situation; they are skilled at objectively organizing material, weighing the facts, and impersonally judging whether something is true or false. Feeling types, on the other hand, are skilled at understanding other people's feelings and analyzing subjective impressions, basing their judgments on personal values. [Ref. 10: p. 461]

Judging and perception describes the person's preferred way of dealing with the outer world. Judging types are organized and systematic; they live in a planned, orderly way, aiming to regulate life and control it. Perceptive types are more curious and open-minded; they go through life in a flexible, spontaneous way, aiming to understand life and adapt to it. [Ref. 10: p. 461]

In Table I Keirsey and Bates [Ref. 12] have tabulated the differences within the pairs of preferences by words and phrases. [Ref. 13: p. 11]

C. MYERS-BRIGGS TYPE INDICATOR

An instrument based on Jung's theory of personality typology is the Myers-Briggs Type Indicator (MBTI). It was developed in the 1940's through the 1960's by Isabel

TABLE I

DIFFERENCES WITHIN THE PREFERENCES

E (75% of population) vs.	I (25% of population)
Sociability	Territoriality
Interaction	Concentration
External	Internal
Breadth	Depth
Extensive	Intensive
Multiplicity of relationships	Limited relationships
Interest in external events	Interest in internal events
S (75% of population) vs.	N (25% of population)
Experience	Hunches
Past	Future
Realistic	Speculative
Fact	Fiction
Sensible	Imaginative
Actual	Possible
Utility	Fantasy
Practicality	Ingenuity
T (50% of population) vs.	F (50% of population)
Objective	Subjective
Analysis	Sympathy
Impersonal	Personal
Principles	Values
Firmness	Persuasion
Laws	Extenuating circumstances
J (50% of population) vs.	P (50% of population)
Fixed	Flexible
Decisive	Tentative
Decision-making	Treasure hunting
Completed	Emergent
Decided	Gather more data

Legend

E - An extravert
I - An introvert
S - A sensing type
N - An intuitive type
T - A thinking type
F - A feeling type
J - A judging type
P - A perceiving type

Myers-Briggs. The MBTI is a self-report questionaire consisting of 126 forced-choice questions. The aim of the MBTI is to determine habitual choices between opposites. [Ref. 10: p. 462]

The MBTI consists of four scales: Extraversion-Introversion (E-I), Sensation-Intuition (S-N), Thinking-Feeling (T-F), and Judging-Perception (J-P) which result in eight preferences. Each scored item has one answer weighted in favor of one of the eight preferences and the other answer weighted in favor of the opposing preference. Different weights have been assigned to certain answers in an attempt to offset social desirability bias. [Ref. 10: p. 462]

The Indicator yields two types of scores for each person. It classifies respondents on four dichotomous type categories, and it also produces eight numerical scores which can be transformed into four continuous scores. [Ref. 10: p. 462]

To determine the person's type, the points for each preference are totalled, yielding eight numerical scores. These eight scores are interpreted as four pairs of scores, with the larger of each pair indicating the preferred pole. For example, a person with an E score of 12 and an I score of 17 is typed as an introvert. The final result is that a person is classified as one of 16 possible types: ISTJ, ISFJ, INFJ, INTJ, ISTP, INFP, ISFP, INTP, ESTP, ESFP, ENFP, ENTP, ESTJ, ESFJ, ENFJ, or ENTJ. An ISTJ, for example, means an introvert preferring sensing and thinking and a mainly judging attitude toward the world. [Ref. 10: p. 462]

Determining continuous scores with the MBTI is a more complex procedure than determining type-category scores. For each of the four scales, the difference between the person's two numerical scores is calculated and then transformed into one continuous score. Four continuous scores are thus

calculated for each person, one score for each scale. Continuous scores are all odd numbers, ranging from 33 to 161, with 100 serving as the division point which separates the two opposing preferences. For example, a person with a continuous score of 143 on the E-I continuum is regarded as strongly introverted. [Ref. 10: p. 462]

It is important to recognize that the MBTI measures only preference toward a certain type. If one has a high score on one dimension, the other dimension on the continuum is viewed as complementary. The MBTI does not necessarily indicate that an individual is deficient with regard to a particular dimension if he/she receives a low score; it only indicates a preference for the complementary score. [Ref. 3: p. 46]

Many researchers have investigated the relative independence of the four scales of the Myers-Briggs Type Indicator by computing intercorrelations between the scales. In some cases, MBTI scores were treated as dichotomous type categories and in other cases, MBTI scores were regarded as continuous data. [Ref. 10: p. 462]

Taken together, the findings with both type-category scores and continuous scores indicate that the Myers-Briggs Type Indicator measures three dimensions of personality which are relatively independent of each other: extraversion-introversion, sensation-intuition, and thinking-feeling. The instrument also measures a fourth dimension of personality, judgment-perception, which appears to be related to at least one of the other dimensions (S-N). [Ref. 10: p. 463]

The middle two dimensions of the MBTI (sensing-intuition, S-N, and thinking-feeling, T-F) are the ones most often used to test the hypothesis that users and analysts have different cognitive styles. The S-N dimension corresponds to the kind of "input mode" an individual

prefers while the T-F corresponds to an individual's "decision making process" preference in processing input data. Combining the two data input modes with the two decision making modes in all possible ways results in the four Jungian personality types: sensing-thinking (ST); intuition-thinking (NT); sensing-feeling (SF); and intuition-feeling (NF) The advantage of this four type Jungian classification is that it helps make clear the conflicts between individuals. The ST and NF types are opposed to one another since they are based upon conflicting preferences for information and decision making styles. In the same way, NT and SF are opposite to one another [Ref. 3: p. 47]

The Sensation-Thinking (ST) type is one who sees information as concrete facts, turning the specific facts into a formal solution according to some well-defined set of rules. This person wishes to work on specific, clear problems and will probably have a low tolerance for ambiguity. [Ref. 11: p. 332]

The Intuition-Feeling (NF) type will observe input data in the same way as the NT, but it will be judged in a personal or value-laden manner. This personality is subjective and does not follow formal rules of logic. [Ref. 11: p. 332]

The Intuition-Thinking (NT) type is the one who observes and inputs data from a holistic or system type of framework, seeing things, perhaps, not as they are but as they can be. The output or evaluation of these possibilities is judged in accordance with some formal rules and tend to be objective or impersonal. [Ref. 11: p. 332]

The Sensation-Feeling (SF) type also prefers to observe concrete facts apart from the total picture but is less formal in evaluation of the data. This person does not apply the facts formally, but utilizes instead a subjective, value-laden assessment. [Ref. 11: p. 332]

D. STUDIES USING THE MBTI

This section reports the results of some studies that used the MBTI to measure cognitive style.

Ghani [Ref. 14] found that Thinkers and Feelers differ in terms of performance and time needed in a reasonably complex decision making task using different information formats. Thinkers prefer and do better using tabular formats and Feelers do better using graphical displays. Ghani also used the Embedded Figures Test (EFT), but did not find any significant differences. Keen [Ref. 9] reports that cognitive "specialists", individuals previously identified as marked systematics or intuitives, showed predictable differences in problem solving strategies and choice of task. [Ref. 15: p. 34]

McCaulley and Natter [Ref. 16] found significant differences among types in terms of preferred learning activities. Sensing types need experience with the real thing before learning the symbols while Intuitive types prefer independent study. [Ref. 15: p. 34]

De Waele [Ref. 17] reports a number of relationships between MBTI type and decision making processes in marketing. Introvert-Perceptive types report problems in getting things done and Extravert-Judging types report problems in handling uncertainty. The Intuitives enjoy problem finding and the Sensing types prefer problem solving. Feelers enjoy the implementation or execution phases more than the Thinkers. [Ref. 15: p. 34] MacKinnon [Ref. 18] in a widely publicized study, shows that creativity is strongly associated with the Intuitive dimension. Sensing types are rarely found in fields associated with research or creative activities. [Ref. 15: p. 35]

Slocum [Ref. 19] found clear differences in change agent strategies. The Sensing-Thinker's overall preferred strategy is behavior modification, the Sensing-Feeler's is

transactional analysis, and the Intuitive-Thinker's is survey feedback. The Intuitive-Feelers used a much broader range of strategies with no one dominating. [Ref. 15: p. 35]

Mitroff and Kilman [Ref. 20] have produced some striking studies that show different organizations attract different types and vice versa. They used subjects' stories as a means of eliciting their concept of an ideal organization. Managers of the same MBTI type tend to tell the same type of story and thus have similar ideals. ST's stories focus on factual details, the physical features of work, impersonal organizational control, certainty, and specificity. NT's focus on broad global issues and theories of organization and are impersonally idealistic. NF's stories are global in scope, general, personal and humanistic; their ideal organization has a mission to serve mankind. SF's emphasize fact and precision, human relations, and individual rather than global values. [Ref. 15: p.35]

Nutt and Henderson [Ref. &nutt] gave the MBTI to a group of executives to determine their cognitive styles. Then they were given reports of eight expansion projects and asked to make a decision on whether to adopt or reject the project and also the amount of risk they believed was associated with the project.

Cognitive style influenced the choices made by the executives in this study. The adoption prospects and perception of risk were found to be related to the executive's psychological makeup. Different styles were found to react quite differently to the same decision. [Ref. 6: p. 384]

E. VALIDITY OF THE MBTI

The validity of the Myers-Briggs Type Indicator is dependent on how well it measures what it was intended to measure: the theoretical constructs of Jung's typology. Three types of validity are examined below: content

validity, predictive validity, and construct validity. [Ref. 10: p. 467]

1. Content Validity

Myers' extensive account of the Indicator includes the criteria used for choosing and scoring items, and provides considerable evidence for the instrument's content validity. Stricker and Ross [Ref. 21] also examined item content, concluding that the S-N and T-F scales seem largely consistent with their corresponding conceptual definitions, but the E-I and J-P scales may measure something quite different from the dimensions postulated by Myers in the MBTI Manual. The question has not been settled, but it would appear from an inspection of the scored items that the E-I, S-N, and T-F scales are generally consistent with the content of Jung's typological theory. [Ref. 10: p. 468]

Another type of evidence for content validity was obtained by Bradway [Ref. 22] in a study involving 28 Jungian analysts. The analysts were asked to classify themselves according to the E-I, S-N, and T-F type categories, and comparisons were then made between self-typing and MBTI typing. There was 100% agreement on E-I classification, 68% agreement on S-N classification, 61% agreement on T-F classification, and 43% agreement on all three dimensions. The E-I index thus proved to be remarkably valid for the sample of Jungian analysts. [Ref. 10: p. 468]

Additional evidence for content validity has been obtained by correlating subjects' MBTI scores with their scores on the Gray-Wheelwright Questionnaire, another instrument designed to identify Jungian types. The Gray-Wheelwright is similar to the Indicator in that it uses continuous scores to assign subjects to type categories, but it has no J-P scale. [Ref. 10: p. 468]

Bradway's study of 28 Jungian analysts compared their scores on the two intruments, and found that 96% of

the analysts received the same E-I classification with both tests, 75% received the same S-N classification, 72% received the same T-F classification, and 54% received identical classifications on all three dimensions with both tests. The proportion of agreement between the tests was significantly higher than would be expected by chance. [Ref. 10: p. 468]

2. Predictive Validity

Three studies have examined the Indicator's ability to predict choice of major and success in college. Goldschmid [Ref. 23] derived regression equations to forecast college major for two samples of undergraduates, and found that the Indicator's scales had moderate predictive validity. In another study, Conary [Ref. 24] predicted that certain specific personality types in his sample of 1709 entering freshmen would be more likely than other types to receive good grades and to make specific curricula choices during their freshman year, and the predictions were substantiated. Stricker at al. [Ref. 25] conducted a similar study with three samples of entering freshmen and concluded that the Indicator's scales had some ability to predict GPA and dropout, but this ability varied considerably with the nature of the sample. They found that a contingency measure combining all four type categories generally had greater predictive validity than did the individual scales. [Ref. 10: p. 468]

The studies cited above suggest that the MBTI has moderate predictive validity in certain areas. [Ref. 10: p. 469]

3. Construct Validity

Several researchers have used factor analysis to investigate the relationship between the constructs measured by other tests. Saunders [Ref. 26] compared the continuous MBTI scores of 1132 subjects with their scores on the

Allport-Vernon-Lindzey Study of Values (AVL), an instrument based on Spranger's theory of types. Factor analysis revealed that the four Jungian type dimensions formed a good simple structure and both instruments appeared to be measuring related constructs. In studies by Madison et al. [Ref. 27] and by Ross [Ref. 28] factor analysis was used to relate a variety of tests to the Myers-Briggs Type Indicator. In all of the studies, the four MBTI scales tended to have substantial loadings on different factors, lending support to Myers' premise of a four dimensional interlocking structure of personality. [Ref. 10: p. 469]

Numerous correlation studies have been conducted with the Myers-Briggs Type Indicator comparing MBTI scores with scores on other instruments. Although there have been few attempts to specify beforehand the expected behaviors of each personality type, a wealth of circumstantial evidence has been gathered and results appear to be quite consistent with Jungian theory. [Ref. 10: p.469]

The above discussion and studies indicate that the MBTI is a reasonably valid instrument and therefore supports the case that the MBTI is a suitable tool for determining cognitive style.

III. MEASURING GROUP PERFORMANCE

The previous chapter examined how to measure cognitive style and determined that the Myers-Briggs Type Indicator (MBTI) was the most suitable tool to use. This chapter will focus on how to measure group performance. From these measures one or more of them will be selected as a suitable standard for predicting the performance of systems development groups. The Myers-Briggs Type Indicator could then be given to each member of these groups to see if there is a difference in the Jungian types that appear in successful system development groups and the Jungian types that appear in unsuccessful groups.

A. VARIABLES AFFECTING GROUP PERFORMANCE

There are many factors which influence group performance. They include physical environment, group size, group composition, leader behavior, ability, attitudes, personality characteristics, and expectations. Each of these variables will be discussed briefly in this section.

1. Physical Environment

The setting in which the group interaction occurs often exerts an important influence on the problem solving process. The performance of groups may be promoted by such mundane aspects of the environment as proper lighting, pleasant wall colors, soundproof walls, and esthetically pleasing environments. Less obvious, perhaps, are the indirect effects of the environment on group problem solving. For instance, interperson distances affect the perception of status differences, which in turn affect group process and hence problem solving effectiveness. Seating arrangements affect the amount of interaction between group members, quality of interaction, positive cooperation, and personal

feelings of group members. All these variables that are related to seating arrangements are known to influence group problem solving. Communication among group members is encouraged by a seating arrangement that permits easy eye contact, and interpersonal communication generally improves decision making and problem solving. [Ref. 29: p. 392]

2. Group Size

The sheer number of persons in the group has also been shown to influence group performance. When the task or problem is one that permits the addition of individual member contributions or can be solved if a single group member can solve it, increasing the size of the group facilitates group performance. On such tasks, the unique abilities and resources of individual group members can be used to improve problem solving effectiveness. When the task or problem is one that can be solved only if each and every group member can solve it, group performance is enhanced by decreasing the size of the group. The size of the group also affects some aspects of group process that may be expected to influence group problem solving. As the size of the group increases, the distribution of participation among group members becomes more unequal: a relatively small proportion of the group's membership contributes most of the total participation. A further consequence of this is that many good ideas may not be expressed by minority group members. Smaller groups are less likely to exemplify this unequal participation and hence should be more effective than larger groups, unless other factors counteract its effect. [Ref. 29: p. 393]

3. Group Composition

The particular combination of personal characteristics of group members is an important factor in group problem solving. The assembly factors that are of special significance for group problem solving are group

cohesiveness, compatibility, and heterogeneity of group membership. Although these aspects of group composition are not independent, the specific relationships among group-member characteristics that are considered vary with the type of assembly factor. [Ref. 29: p. 394]

Group cohesiveness refers to the degree to which group members are attracted to each other and to the group, or, more precisely, the resultant of all those forces acting on the person to remain in or to leave the group. Group members who are attracted to the group presumably want the group to succeed and, therefore, work harder to help the group achieve its goals. It follows that group problem solving should be facilitated by group cohesiveness. [Ref. 29: p. 395]

Group compatibility may be considered a more general assembly characteristic than cohesiveness, although both factors refer to harmonious relations among group members. The general findings from studies indicate that compatible groups are more effective than incompatible groups. [Ref. 29: p. 395]

Another aspect of group composition that influences group performance is the degree to which the personal characteristics of group members are similar or dissimilar. Most problem solving requires a variety of abilities, skills, and knowledge: therefore, heterogeneous group composition should facilitate group problem solving. Much of the research in this area has been devoted to ability heterogeneity-homogeneity. Some studies failed to find the expected relationship, but the majority of studies find that heterogeneous ability groups are more effective than homogeneous ability groups. Heterogeneity with respect to personality characteristics also appears to facilitate group problem solving. [Ref. 29: p. 395]

4. Leader Behavior

One of the most pervasive beliefs in our society is that "good" leadership promotes effective group action. Empirical evidence on group problem solving generally supports this belief, although what constitutes "good" leadership is often controversial. Groups with leaders, in comparison with leaderless groups, usually are more effective problem solvers, although the degree to which this is so depends upon the source of the leader's authority. More importantly, the kind of behavior exemplified by the leader influences group effectiveness. In general, a leader who provides direction and structure for the group facilitates group problem solving. [Ref. 29: p. 396]

5. Abilities Of Group Members

The abilities of the group members determine how effectively they can perform tasks in the group. Abilities may be general (intelligence) or they may be specific to the particular situation or task faced by the group. Intelligence is an estimate of the individual's ability to deal with a variety of situations and problems. It is presumed to be determined by both innate ability and the experiences that the individual has had during his or her lifetime. The data regarding this general ability and behavior in groups are based upon measures of intelligence obtained by means of standard intelligence tests. [Ref. 29: p. 188]

The most extensive studies involving intelligence and group behavior have been in the field of leadership. Leaders of effective Army squads have a significantly higher mean intelligence score than leaders of ineffective squads [Ref. 30] The relation between leader intelligence and performance is supported by Haven and McGrath [Ref. 31] who also found a correlation between unit effectiveness and leader intelligence. Leader intelligence, with job

knowledge, shared the position of the best leader trait for predicting group effectiveness. Intelligence has also been found to be related to general activity, popularity, and conformity of individual group members. The evidence indicates that the more intelligent individual tends to be more active and less conforming in groups than the less intelligent person. As a partial consequence, he or she is more effective as a leader than the less intelligent group member. [Ref. 31: p. 249]

Specific abilities are more directly related to behaviors in the group and hence exert a more powerful effect upon group process. The specific abilities that are of interest include not only those which may be reflected in general ability, but also special skills and knowledges. Task related abilities reflect the possession of special knowledges and skills which enable the individual to aid the group in achieving its goal. This has been demonstrated in a number of studies in which the individual group member was provided with task relevant information by the experimenter. [Ref. 29: p. 190]

In general, if an individual has specific abilities that are related to the group task, he or she will be more active in the group, will make more contributions to the group's attempts to complete the task, and will have more influence on the group's decisions. Measures of both general and specific ability of individuals have been used to predict small group performance. [Ref. 29: p. 191]

6. Attitudes

The attitudes of the members of the group toward the system task to be accomplished are important indicators of the quality of task performance. Favorable attitudes by the group members toward the task has been found to be positively correlated with the quality of the outcome. It is critical that the attitudes be compatible. It is believed

that poor quality of task solutions is the result of incompatible attitudes. [Ref. 32: p. 631]

7. Personality Characteristics

The personality characteristics of members may also influence the degree to which the abilities and skills of group members can be employed to facilitate group problem solving. For example, sociability and social activeness are positively related to group performace. Group problem solving is also facilitated if group members display individual prominence tendencies , self reliance, dependability and/or emotional stability and personal adjustment. [Ref. 29: p. 394]

8. Expectations

System development efforts can be viewed as a multistage process. During the first of the stages, Definition, most of the key decisions about the system as the user will see it are made, i.e. system goals, scope, overall approach. The Definition stage, however, typically accounts for no more than 25% of the resources required for system development. Thus, the decisions which will have the greatest effect on the user's acceptance or rejection of a system are made prior to the bulk of spending on the project, and an assessment of the project's probability of success or failure should be possible at that time. [Ref. 33: p. 459]

The results of a number of studies suggest that system failure is more likely when users hold unrealistic expectations about a system. Research in other areas, especially product evaluation and job satisfaction, also shows a connection between realism of expectations and outcomes. Thus, user expectations held at the end of the Definition stage might serve as early warning indicators of system outcomes. Results of studies strongly suggest that users who hold realistic expectations are more satisfied with the system and use it more than users whose expectations are unrealistic. [Ref. 33: p. 459]

B. SELECTING A GROUP PERFORMANCE MEASURE

The objective of selecting a group performance measure is to have a standard which can be applied to each member of the systems development group to predict the task performance of the group before they actually begin meeting. If each member of the group meets or surpasses the standard, then successful performance of the group will be predicted. On the other hand, if one or more of the members fails to meet the standard then poor group performance will be predicted.

In reviewing the variables that affect group performance presented in the previous section, there are two that can be used to predict group performance prior to the group actually meeting. The variables are "specific abilities" and "intelligence". There is no way to actually measure the other variables and the effects of the other variables can only be determined during group performance.

The "intelligence" variable can be measured by selecting a standard intelligence test to give to each member of the group. "Specific abilities" can be measured by determining the amount of education and/or experience that each member has had as a program manager, a user, or an analyst.

The author realizes that these two measures of group performance do not account for all the variations in the performances of groups, but the they are suitable to use for studying system development groups.

IV. COGNITIVE STYLE AND GROUP PERFORMANCE

This Chapter will examine two case studies that indicate that the cognitive styles of members of system development groups are related to their performance. These studies also provide evidence that a mix of cognitive styles within system development groups are more successful than ones that contain only one or two different cognitive styles.

A. CASE STUDY ONE

Kaiser and Bostrom [Ref. 3] conducted a two phased study that consisted of first investigating the personality characteristics of some users and analysts who worked on system development teams and then exploring the relationship between these differences and system success/failure. The Myers-Briggs Type Indicator was used to determine the personality characteristics of the subjects of this study. [Ref. 3: p. 43]

The basic objective of phase one of the study was to test the hypothesis that users and analysts are different with respect to the specific dimensions of the Jungian typology. The particular focus of the study was on those dimensions most likely to produce conflicts if differences existed. [Ref. 3: p. 47]

The hypotheses concerning the basic personality dimensions are as follows:

- Analysts are more introverted than users
- Users tend to be more intuitive than analysts
- Users tend to prefer the feeling dimension while analysts prefer the thinking dimension
- Users tend to be more perceptive, while analysts are more judgmental
- Users show a greater occurrence of NF and SF types, while analysts show a greater occurrence of ST and NT orientations.

[Ref. 3: p. 47]

The results of the MBTI indicate no differences between users and analysts on the extraversion-introversion, thinking-feeling, and judgment -perception dimensions. They do differ on the sensing-intuition dimension. However, the difference is the reverse of what was expected. Users were proportionately more S than N while analysts were fairly balanced on this dimension. [Ref. 3: p. 47]

The results pertaining to the combination of the two middle dimensions of the MBTI indicate a significant difference in types between users and analysts, but not what was expected. The only expected result verified was that analysts tended to show a stronger thinking than feeling orientation. A greater proportion of the users were STs than analysts. The ST type is the typical stereotype of analysts. There were minor differences in the numbers of SF and NF types; the important finding was a lack of them. [Ref. 3: p. 47]

The lack of feeling (F) types and similarities between users and analysts raised several questions. This caused an investigation of other variables by Kaiser and Bostrom in which it was discovered that the "users" in the study were not actually the end users of the systems being developed but "user representatives". Two related questions emerged from this finding: (1) do user populations contain a higher percentage of F's than the ones tested, and (2) are user representatives more "system oriented" than the typical end user? [Ref. 3: p. 50]

In order to investigate these questions phase two of the study was conducted. Kaiser and Bostrom [Ref. 3] carried out a case study on the implementation of an integrated Human Resources Information System in a large multi-campus university. The system was integrated in that it provides information to multiple departments and functions on each campus from a single database. The university had made four

attempts to implement this system over a thirteen year span: the first three were failures, the last one a success. [Ref. 3: p. 50]

Although there were many reasons for the failure effort, a few stand out. The effort was viewed primarily as a technical change; the focus, therfore was on the computer based system. Little attention was paid to organizational and social/people problems. The effort developed an integrative system without an integrative organization to operate and manage the system. The major problems of the environment were organizationally based and a technical solution would not solve them. In fact, the technical solution merely highlighted them and made them worse. [Ref. 3: p. 50]

The computer based system was poorly designed. The online and batch user interfaces were designed primarily from a technical designer's perspective rather than the needs of the users. The initial information requirements were inaccurate and incomplete. Modifications to correct initial requirement deficiencies were very difficult. The deficiencies in requirements were due primarily to inadequate end user involvement and poor analysis by user representatives and analysts. In terms of involvement, all relevant users were not represented and the analysts were not working with the end users of the system. The poor analysis was the result of the user not having good completed models of their work systems. Therefore, they had difficulty in articulating their needs. Instead of helping users build good models, analysts and user representatives would get initial ideas from users and then analysts would construct the system with little feedback to the users. The final models embedded in the system were, therefore, more reflective of analysts and user representatives' perspectives. [Ref. 3: p. 50]

In addition, the project team was not managed very well. In particular, the role relationships between users, user representatives, and analysts were not clear or well developed. [Ref. 3: p. 51]

In the successful effort, the Socio-Technical Systems (STS) design methodology was utilized to ensure equal attention to technical and social systems issues. A prototyping design approach was utilized to implement a purchased software package. The prototype approach, combined with the use of structured design methods, allowed the development of good user models and needs statements. [Ref. 3: p. 51]

The higher level indirect users who were analysts in the failure effort became members of a steering committee that made decisions on policy, resources, and organizational issues and monitored the activities of the project teams. The selection of analysts, users, and user representatives to be members of the design team was based on their relative technical and social skills. The selection criteria were to maintain a mix of good technical and social skills on the team. This was accomplished by having people that possessed both types of skills and a combination that excelled in one or the other. [Ref. 3: p. 51]

The newly formed project team was given the Myers-Briggs Type Indicator to determine their cognitive styles. The results were shared with the project team members allowing them to examine their underlying values, assumptions, and the strengths/weaknesses of their problem perspectives. This type of sharing helped create a climate for integrative problem solving. [Ref. 3: p. 51]

The results of the MBTI revealed that the failure team consisted of only sensing-thinking (ST) and intuition-thinking (NT) types of people. The team was completely void of any feeling (SF or NF) types. On the other hand, the success team consisted of members of all four Jungian types.

The selection criteria for each team were very different. The failure effort selected users to be on the project team based on their similarity to their analyst counterparts, while the selection criteria for the success team were to get a representative set of users and analysts that possessed a mix of social and technical skills. These different criteria provide the best explanation of the differences in the distribution of cognitive styles. The mix of Jungian types in the success team was one of the factors in the development of an integrative/ balanced problem solving perspective. The findings indicate that the development of an integrative problem solving perspective is critical to successful implementation. [Ref. 3: p. 52]

The results from the first phase of the study indicate that users are very similar to their analyst counterparts. In fact, users appeared to be more "systems oriented" than their analyst counterparts. Due to the lack of Fs, one would expect the system development team to be relatively free of conflict. This does not support the contention in Chapter I that a communication gap exists between users and analysts. [Ref. 3: p. 52]

The second phase of the study reported that the "users" were not really the end users of the system. This implies a lack of involvement in systems development by users who probably are most affected by the system and who possibly are very different in personality characteristics than the user representatives. [Ref. 3: p. 52]

B. CASE STUDY TWO

To further investigate Kaiser and Bostrom's [Ref. 3] findings, a case study of two project teams was conducted by White [Ref. 34]. The specific objective was to identify the individual Jungian styles represented on the project teams and to determine through interview data, if the teams' performance differed. [Ref. 34: p. 97]

The MBTI was administered to two project teams with ten employees assembled on each team. Only the middle two dimensions, sensing-intuition, S-N, and thinking-feeling, T-F, were utilized. On project team one, there were 7 STs and 3 NTs; there were no SF or NF types. Project team two was more evenly distributed. There were 4 SFs, 2 NTs, 2 SFs, and 2 NFs. [Ref. 34: p. 97]

Project team one was assigned responsibility for a computerized order-entry system. Work on this system continued for two years until it was discovered that the base design did not support an enhanced product line created during system development. [Ref. 34: p. 97]

It was generally recognized that a planned product line would necessitate a revision of the existing product structure code, but it was considered a maintenance problem that could be dealt with after system implementation. It became a critical design factor when it was discovered that the code could not accurately describe the enhanced product line, nor could it be easily revised. At this point it was determined that much of the extremely technical programming modules were built around the existing code. The decision was made that it would be more cost effective to abandon the current order-entry system and to begin again. [Ref. 34: p. 97]

An analysis of interview data relating to project team one revealed a very technical orientation in their systems development activities. When users described project team one, the term "technicians" surfaced repeatedly. [Ref. 34: p. 97]

Project team two was also evaluated. The interview data revealed quite different results. Evaluations of project team two centered around three main topics: communication skills, user satisfaction, and overall work accomplishments. Project team two was rated as superior. [Ref. 34: p. 98]

Effective communication skills surfaced as a component that distinguished this team. Documentation was mentioned as complete and comprehensible for the systems completed. Users consistently expressed satisfaction, not only with the end products or systems produced but also with the process used. [Ref. 34: p. 98]

The most outstanding work accomplishment credited to this project team was the successful redesign and implementation of the order-entry system. Obviously, efforts by project team one identified certain pitfalls to avoid in the design of the order-entry system, but product enhancement had increased the complexity of this system to the point that, in essence, project team two had the task of designing a new system. [Ref. 34: p. 98]

The assessment of styles represented on project team one revealed a complete void of feeling individuals (SF and NF) present on the project team. The two existing styles (NT and ST) prefer evaluating information as a thinker. The one-sided perceptual activities of a team with the same information-evaluating preference is addressed by Myers: "If people are exactly the same type, they will understand each other very well but will not make the strongest team because they will be prone to commit the same mistakes". [Ref. 34: p. 98]

While many factors may be considered contributors to the failure of any project, the results of this study indicate that the perceptual homogeneity of project team one cannot be overlooked as a component affecting not only the design of the failed system but other aspects of their work as well. [Ref. 34: p.98]

Project team two contained all four perceptual styles. Feelers, as a counterpart to thinkers, were present on this team to evaluate the information. Perhaps Myers put it best when she said "thinkers need feelers to forecast what others

will feel and to understand the intent beyond spoken words". [Ref. 34: p. 98]

These findings present preliminary evidence that "feelers" add a needed dimension to the work of project teams. While there may have been other contributing factors to the success of project team two, the results of this study strongly suggest that perceptual heterogeneity may lead to better team performance. [Ref. 34: p. 98]

V. SUMMARY AND CONCLUSIONS

This thesis has studied the following questions:

- How do you measure cognitive style?
- How do you measure group performance?
- Are the cognitive styles of members of system development groups related to the performance of the group?
- What is the appropriate balance of cognitive styles within system development groups to ensure effective systems analysis?

Chapter II provided some background material on different cognitive style frameworks. The Jungian typology was selected as the most suitable framework because it has been operationalized in the Myers-Briggs Type Indicator. Evidence was presented that suggested that the MBTI is a valid instrument for measuring cognitive style.

In Chapter III, variables such as physical environment, group size, group composition, leader behavior, abilities of group members (intelligence and specific ability), personality characteristics, attitudes, and expectations were found to influence group performance. Intelligence and specific ability were determined to be the most appropriate measures of group performance.

Chapter IV attempted to provide answers to questions 3 and 4. In the author's opinion, the case studies indicate that the cognitive styles of members of system development groups are related to the performance of the group. The case studies also indicate that all four Jungian types should be represented on system development groups to ensure successful system analysis and design, but no evidence was found to indicate how many of each type is an appropriate mix.

With the information provided in this thesis, the author recommends that a study be conducted to determine what the

appropriate mix of cognitive styles is to ensure effective system design. Using one or both of the group performance measures from Chapter III, the performance of system development groups could be predicted. Then the MBTI could be used to determine the cognitive styles present in the groups. If a pattern is seen in the cognitive styles of either the successful groups or the unsuccessful groups, then an appropriate mix can be determined.

Once the mix of cognitive styles has been determined for a successful group performance, the MBTI can be given to members of prospective system development groups to see if they are similar to the appropriate mix. If they are not similar, then a possible exchange of people for the group should be considered.

In summary, the author's conclusions are:

- The cognitive styles of members of system development groups are related to a successful or unsuccessful group performance
- The MBTI is a reliable measure of cognitive style and can be used successfully to determine the cognitive styles of members of system development groups
- There is a mix of cognitive styles that will provide consistent successful performance, but further research is required to find it.

LIST OF REFERENCES

1. Booth, Grayce M., The Design of Complex Information Systems, pp. 7-30, McGraw-Hill, 1983.

2. Edstrom, Anders, "User Influence and the Success of MIS Projects: A Contingency Approach", Human Relations, Vol 30,No. 7, 1977, pp. 589-607.

3. Kaiser, K.M and Bostrom, R.P., "Personality Characteristics of MIS Project Teams: An Empirical Study and Action-Research Design", MIS Quarterly, December 1982, pp. 43-60.

4. Carroll, A.B., "Behavioral Aspects of Developing Computer-Based Information Systems", Business Horizons, Jan-Feb 1982, pp. 42-51.

5. Huysman, J.H.B.M., "The Effectiveness of the Cognitive Style Constraint in Implementing Operations Research Proposals", Management Science, Vol 17, No. 1, September 1970, pp. 92-104.

6. Henderson, J.C. and Nutt, P.C., "The Influence of Decision Style On Decision Making Behavior", Management Science, Vol 26, No. 4, April 1980, pp. 371-386.

7. Witkin, H.A., "A Cognitive Style Approach to Cross Cultural Research", International Journal of Psychology, Vol 2, 1967, pp. 233-270.

8. Driver, M.J. and Mock, T.J., "Human Information Processing, Decision Style Theory, and Accounting Information Systems", Accounting Review, July 1975, pp. 490-508.

9. McKenney, J.L. and Keen, P.G.W., "How Managers' Minds Work", Harvard Business Review, May-June 1974, pp. 79-90.

10. Carlyn, Marcia, "An Assessment of the Myers-Briggs Type Indicator", Journal of Personality Assessment, 1977, Vol 41, No. 5, pp. 461-473.

11. White, K.B., "A Preliminary Investigation of Information Systems Team Structures" Information and Management, Vol 7,1984, pp. 331-335.

12. Keirsey, D. and Bates, M., Please Understand Me, Del Mar, CA: Prometheus Nemesis Book, 1978, p. 25.

13. Nidiffer, K.E., "The Personality Factor", Program Manager, Vol 13, No. 4, July-August 1984, pp. 10-18.

14. Ghani, J.A., The Effects of Information Representation and Modification on Decision Performance, Ph.D. Dissertation, Wherton School, University of Pennsylvania, August 1980.

15. Keen, P.G.W. and Bronsema, G.S., "Cognitive Style Research: A Perspective for Integration", Proceedings of the Second International Conference on Information Systems, December 1981.

16. McCaulley, M.H. and Natter, I.L., "Psychological (Myers-Briggs) Type Differences in Education", Natter and Rollin, eds., The Governor's Task Force on Disruptive Youth: Phase II Report, Tallahassee, Florida, Office of the Governor, 1974.

17. De Waele, M., Managerial Style and the Design of Decision Aids, Ph.D. Dissertation, University of California, Berkeley, California, May 1978.

18. MacKinnon, D.W., "The Nature and Nurture of Creative Talent", American Psychologist, 1962.

19. Slocum, J.W., Jr., "Does Cognitive Style Affect Diagnosis and Intervention Strategies of Change Agents?", Group and Organization Group and Organization Studies, Vol 3, No. 2, June 1978.

20. Mitroff, I.I. and Kilman, R.H., "Stories Managers Tell: A New Tool for Organizational Problem Solving,", Management Review, July 1975.

21. Stricker, L.J. and Ross, J., "Intercorrelative and Reliability of the Myers-Briggs Type Indicator Scales", Psychological Reports, 1963.

22. Bradway, K., "Jung's Psychological Types: Classification by Test Versus Classification By Self", Journal of Analytical Psychology, 1964, Vol 9, pp. 129-135.

23. Goldschmid, M.L., "Prediction of College Majors by Personality Type", Journal of Counseling Psychology, 1967, Vol 14, pp. 302-308.

24. Conary, F.M., "An Investigation of the Variability of Behavioral Response of Jungian Psychological Types to Select Educational Variables", Dissertation Abstracts, 1966, Vol 26, pp. 5222-5223.

25. Stricker, L.J., Schiffman, H., and Ross, J., "Predictions of College Performance With the Myers-Briggs Type Indicator", Educational and Psychological Measurement, 1965, Vol 25, pp. 1081-1095.

26. Educational Testing Service Report RB 60-6, The Existence of a Rational Correspondence Between the Personality Typologies of Spanger and Jung, by D.E. Saunders, 1960.

27. Princeton University Counseling Service Statistical Report Number 13, The Myers -Briggs Type Indicator in Academic Counseling, by P. Madison, D.H. Wilder, and W.B Suddiford, July 1963.

28. Ross, J., "The Relationship Between A Jungian Personality Inventory and Tests of Ability, Personality, and Interest", Australian Journal of Psychology, 1966, Vol 18, pp. 1-17.

29. Shaw, M.E., Group Dynamics, McGraw-Hill, 1983.

30. Greer, F.L., Galanter, E.H., and Nordlie, P.G., "Interpersonal Knowledge and Individual and Group Effectiveness", Journal of Abnormal Social Psychology, 1954, Vol 49, pp. 411-414.

31. Heslin, Richard, "Predicting Group Task Effectiveness From Member Characteristics", Psychological Bulletin, 1964, Vol 62, No. 4, pp. 248-256.

32. Kaiser, K.M. and Shrinivasan, A., "User-Analyst Differences: An Empirical Investigation of Attitudes Related to System Development", Academy of Management Journal, 1982, Vol 25, No. 3, pp. 630-646.

33. Ginzberg, M.J., "Early Diagnosis of MIS Implementation Failure: Promising Results and Unanswered Questions", Management Science, April 1981, pp. 459-478.

34. White, K.B., "MIS Project Teams: An Investigation of Cognitive Style Implications", MIS Quarterly, June 1984, pp. 95-101.

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